Climate Change Vulnerability Index Report

Oxytropis campestris var. *wanapum* (Wanapum crazyweed)

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Assessor: Walter Fertig, WA Natural Heritage Program

Geographic Area: Washington — Heritage Rank: G5T1/S1

Index Result: Moderately Vulnerable — Confidence: Very High

Climate Change Vulnerability Index Scores

Section A	**Severity**	**Scope (% of range)**
1. Temperature Severity	>6.0° F (3.3°C) warmer	0
	5.6-6.0° F (3.2-3.3°C) warmer	0
	5.0-5.5° F (2.8-3.1°C) warmer	0
	4.5-5.0° F (2.5-2.7°C) warmer	0
	3.9-4.4° F (2.2-2.4°C) warmer	100
	<3.9° F (2.2°C) warmer	0
2. Hamon AET:PET moisture	< -0.119	0
	-0.097 to -0.119	0
	-0.074 to - 0.096	0
	-0.051 to - 0.073	0
	-0.028 to -0.050	100
	>-0.028	0
Section B		**Effect on Vulnerability**
1. Sea level rise		Neutral
2a. Distribution relative to natural barriers		Unknown (Neutral?)
2b. Distribution relative to anthropogenic barriers		Somewhat Increase
3. Impacts from climate change mitigation		Neutral
Section C		
1. Dispersal and movements		Increase
2ai Change in historical thermal niche		Neutral
2aii. Change in physiological thermal niche		Neutral
2bi. Changes in historical hydrological niche		Increase
2bii. Changes in physiological hydrological niche		Increase
2c. Dependence on specific disturbance regime		Neutral
2d. Dependence on ice or snow-covered habitats		Neutral
3. Restricted to uncommon landscape/geological features		Increase
4a. Dependence on others species to generate required habitat		Neutral
4b. Dietary versatility		Not Applicable
4c. Pollinator versatility		Somewhat Increase
4d. Dependence on other species for propagule dispersal		Neutral
4e. Sensitivity to pathogens or natural enemies		Neutral
4f. Sensitivity to competition from native or non-native species		Neutral
4g. Forms part of an interspecific interaction not covered above		Neutral
5a. Measured genetic diversity		Unknown
5b. Genetic bottlenecks		Unknown
5c. Reproductive system		Neutral

6. Phenological response to changing seasonal and precipitation dynamics	Neutral
Section D	
D1. Documented response to recent climate change	Neutral
D2. Modeled future (2050) change in population or range size	Unknown
D3. Overlap of modeled future (2050) range with current range	Unknown
D4. Occurrence of protected areas in modeled future (2050) distribution	Unknown

Section A: Exposure to Local Climate Change

A1. Temperature: The single occurrence of *Oxytropis campestris* var. *wanapum* in Washington (100%) occur in an area with a projected temperature increase of 3.9-4.4˚ F (Figure 1).

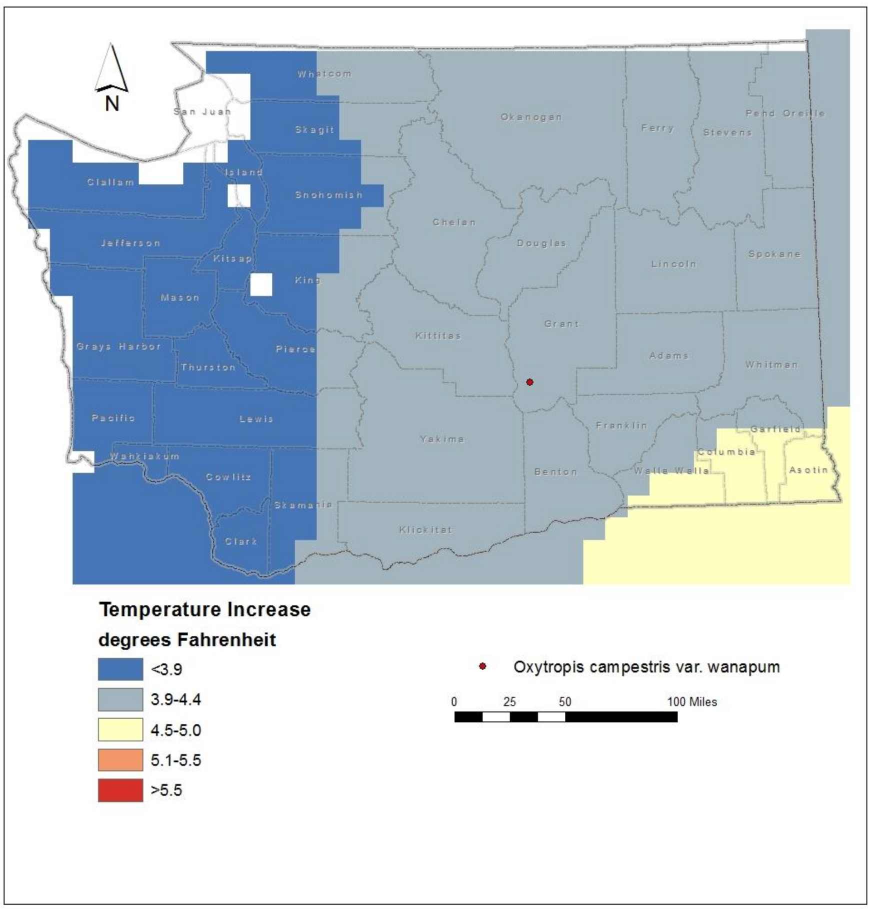

Figure 1. Exposure of *Oxytropis campestris var. wanapum* occurrences in Washington to projected local temperature change. Base map layers from www.natureserve.org/ccvi

A2. Hamon AET:PET Moisture Metric: The single occurrence of *Oxytropis campestris* var. *wanapum* (100%) in Washington is found in an area with a projected decrease in available moisture (as measured by the ratio of actual to potential evapotranspiration) in the range of -0.028 to -0.050 (Figure 2).

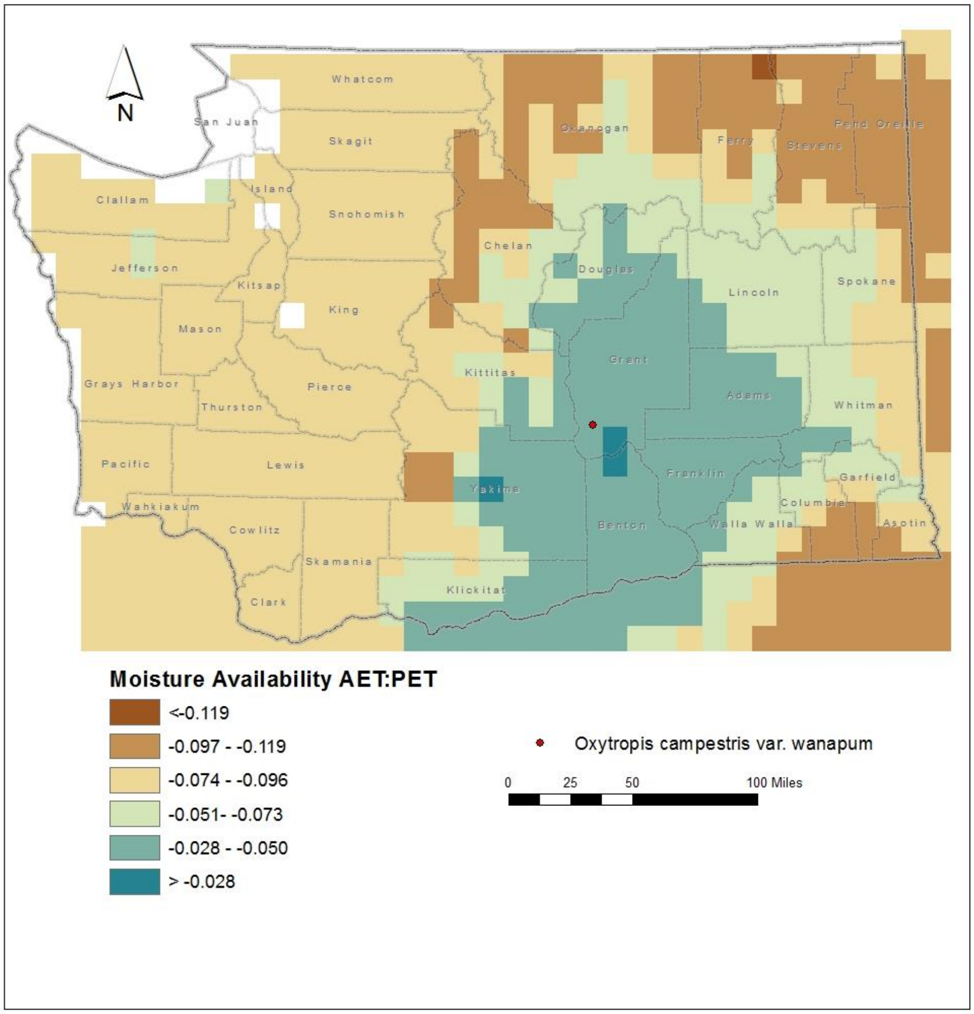

Figure 2. Exposure of *Oxytropis campestris var. wanapum* occurrences in Washington to projected moisture availability (based on ratio of actual to predicted evapotranspiration). Base map layers from www.natureserve.org/ccvi

Section B. Indirect Exposure to Climate Change

B1. Exposure to sea level rise: Neutral.
Washington occurrences of *Oxytropis campestris* var. *wanapum* are found at 1800-2420 feet (550-740 m) and would not be inundated by projected sea level rise.

B2a. Natural barriers: Neutral?
In Washington, *Oxytropis campestris* var. *wanapum* is restricted to a community of *Ericameria nauseosa, Salvia dorrii*, and *Pseudoroegneria spicata* along a narrow band of whitish ashy mudstone or sandstone within thick deposits of brown basalt talus and bedrock near the summit of Saddle Mountain (Fertig 2020). This habitat is a component of the Inter-Mountain Basins Cliff and Canyon ecological system (Rocchio and Crawford 2015). The population extends discontinuously for about 4 1/2 miles. No other populations have been documented in central Washington, although potential habitat could exist on basalt ridges on the Yakima Training Center or Hanford Reservation to the south (Joyal 1990). These potential sites are separated by areas of unsuitable habitat. Whether the range of var. *wanapum* is constrained by its dispersal ability or lack of additional habitat is not known.

B2b. Anthropogenic barriers: Somewhat Increase.
The range of *Oxytropis campestris* var. *wanapum* is apparently restricted to Saddle Mountain, east of the Columbia River and Wanapum Dam. Human development surrounds much of this area and could restrict potential expansion or migration of the species beyond Saddle Mountain.

B3. Predicted impacts of land use changes from climate change mitigation: Neutral.

Section C: Sensitive and Adaptive Capacity

C1. Dispersal and movements: Increase.
Oxytropis campestris var. *wanapum* produces 6 to 12 slightly inflated legume fruits with membranous-leathery walls. In other varieties of *O. campestris*, seeds are dehisced while the fruits are still attached to the infructescence or the entire fruit is the dispersal unit (Barneby 1989). Dispersal distances are probably relatively short (less than 100 meters) and depend on passive means (such as gravity) or movement by seed-caching animals. Genetic data from other varieties of *O. campestris* suggest limited gene flow between populations due to poor dispersal (Chung et al. 2004).

C2ai. Historical thermal niche: Neutral.
Figure 3 depicts the distribution of *Oxytropis campestris* var. *wanapum* in Washington relative to mean seasonal temperature variation for the period from 1951-2006 ("historical thermal niche"). The single known occurrence (100%) is found in an area that has experienced average (57.1-77˚F/31.8-43.0˚C) temperature variation during the past 50 years and is considered atneutral vulnerability to climate change.

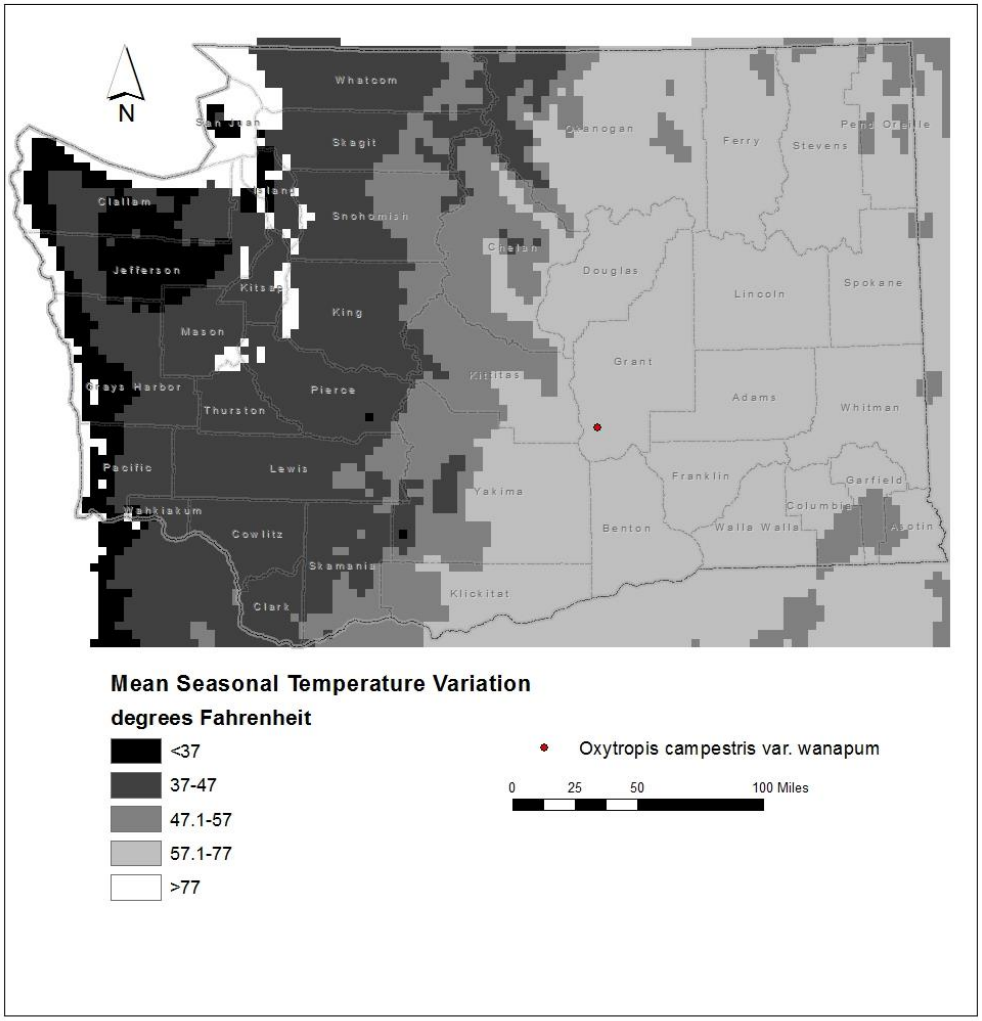

Figure 3. Historical thermal niche (exposure to past temperature variations) of *Oxytropis campestris* var. *wanapum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2aii. Physiological thermal niche: Neutral.
The rock outcrop and habitat of *Oxytropis campestris* var. *wanapum* is not associated with cold air drainage during the growing season and would have neutral vulnerability to climate change.

C2bi. Historical hydrological niche: Increase.
The single population of *Oxytropis campestris* var. *wanapum* in Washington (100%) is found in an area that have experienced small (4-10 inches/100-254 mm) precipitation variation in the past 50 years (Figure 4). According to Young et al. (2016), these occurrences are at increased vulnerability to climate change.

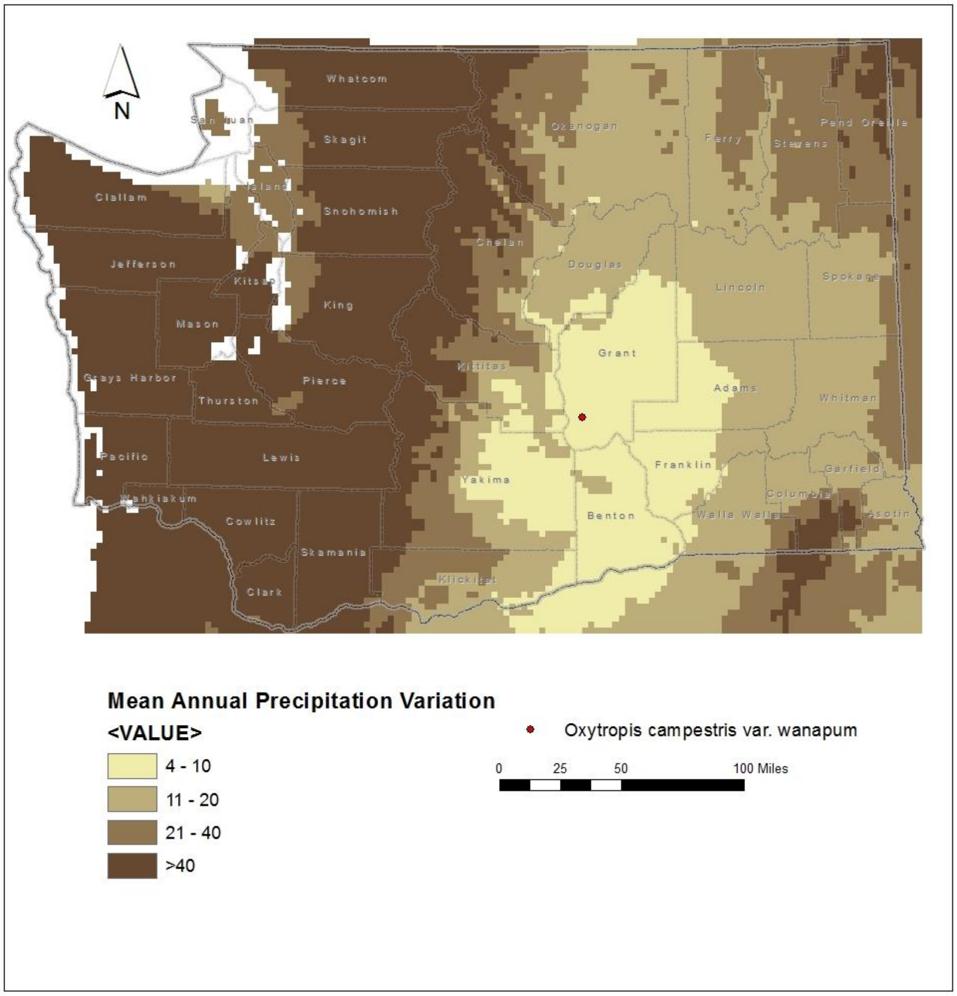

Figure 4. Historical hydrological niche (exposure to past variations in precipitation) of *Oxytropis campestris* var. *wanapum* occurrences in Washington. Base map layers from www.natureserve.org/ccvi

C2bii. Physiological hydrological niche: Increase.
This species is dependent on precipitation and winter snow for its moisture requirements, because its habitat is not associated with springs, streams, or groundwater. The Inter-Mountain Basins Cliff and Canyon ecological system is vulnerable to changes in the timing or amount of precipitation and increases in temperature (Rocchio and Ramm-Granberg 2017).

C2c. Dependence on a specific disturbance regime: Neutral.
Oxytropis campestris var. *wanapum* is not dependent on periodic disturbances to maintain its basin cliff and canyon habitat. The species could, however, be detrimentally affected by increased summer temperatures, drought, or decreased precipitation that might favor conversion of this habitat to lichens or annual plants (Rocchio and Ramm-Granberg 2017).

C2d. Dependence on ice or snow-cover habitats: Neutral.
Snowpack is low in the Saddle Mountain area, but infiltration of snowmelt water may be an important component of the annual water budget.

C3. Restricted to uncommon landscape/geological features: Increase.
Oxytropis campestris var. *wanapum* is restricted to a lens of whitish sandy soil derived from ashy sandstone embedded within thick beds of brown Wanapum Basalt. This geologic layer appears to be uncommon within the Columbia Plateau ecoregion, which may account for the limited range of var. *wanapum*.

C4a. Dependence on other species to generate required habitat: Neutral
The cliff habitat occupied by *Oxytropis campestris* var. *wanapum* is maintained by natural abiotic processes and geologic conditions, rather than by interactions with other species.

C4b. Dietary versatility: Not applicable for plants

C4c. Pollinator versatility: Somewhat Increase.
Joyal (1990) observed the metallic leaf-cutter bee *Osmia integra* visiting *Oxytropis campestris* var. *wanapum* inflorescences. No other pollinators are known. The diversity of insect pollinators may be adversely affected by insecticides used in nearby agricultural fields.

C4d. Dependence on other species for propagule dispersal: Neutral.
The seeds of *Oxytropis campestris* var. *wanapum* are probably dispersed passively by gravity or transported short distances by animals (which may be seed or fruit predators). The number of potential seed vector species is not known.

C4e. Sensitivity to pathogens or natural enemies: Neutral.
Impacts from pathogens are not known. *Oxytropis* species are generally of low palatability due to chemical defense compounds (at least for mammalian herbivores). Weevils (genus *Tychius*) are probably important fruit and seed predators (Joyal 1990).

C4f. Sensitivity to competition from native or non-native species: Neutral.
Oxytropis campestris var. *wanapum* occurs in sparsely vegetated outcrops that currently have relatively low cover and competition from other species. Climate change could shift the composition to more annual plant species, including some that could be invasive exotics (Rocchio and Ramm-Granberg 2017).

C4g. Forms part of an interspecific interaction not covered above: Neutral.
Does not require an interspecific interaction.

C5a. Measured genetic variation: Unknown.
No genetic data are available for var. *wanapum*.

C5b. Genetic bottlenecks: Unknown.

C5c. Reproductive System: Neutral?
Other varieties of *Oxytropis campestris* are obligate outcrossers with low rates of self-pollination or apomixis (Chung et al. 2004). Genetic diversity is relatively high within and between populations of the edaphic endemic, *O. campestris* var. *chartacea* in Wisconsin and other varieties in the *O. campestris* complex (Chung et al. 2004). The degree of genetic divergence is not known for var. *wanapum*. Joyal (1990) suggested that this variety may be most closely allied with var. *columbiana* (an endemic of the upper Columbia River watershed in northern Washington and NW Montana), but no comparative genetic studies have been undertaken. The relatively isolated population of var. *wanapum* might have a reduced genome based on founder effects compared to other varieties.

C6. Phenological response to changing seasonal and precipitation dynamics: Neutral.
Based on herbarium records from the Consortium of Pacific Northwest herbaria website, no changes in the phenology of *Oxytropis campestris* var. *wanapum* populations in Washington have been detected.

Section D: Documented or Modeled Response to Climate Change

D1. Documented response to recent climate change: Neutral.
Significant changes in the distribution of *Oxytropis campestris* var. *wanapum* have not been documented.

D2. Modeled future (2050) change in population or range size: Unknown

D3. Overlap of modeled future (2050) range with current range: Unknown

D4. Occurrence of protected areas in modeled future (2050) distribution: Unknown

References

Barneby, R.C. 1989. Volume Three, Part B Fabales. In: Cronqust, A., A.H, Holmgren, N.H. Holmgren, J.L. Reveal, and P.K. Holmgren, eds. Intermountain Flora: Vascular Plants of the Intermountain West, U.S.A. New York Botanical Garden, Bronx, NY. 279 pp.

Camp, P. and J.G. Gamon, eds. 2011. Field Guide to the Rare Plants of Washington. University of Washington Press, Seattle. 392 pp.

Chung, M., G. Gelembiuk, and T.J. Givnish. 2004. Population genetics and phylogeography of endangered *Oxytropis campestris* var. *chartacea* and relatives: Arctic-alpine disjuncts in eastern North America. Molecular Ecology 13(12): 3657-3673.

Fertig, W. 2020. Potential federal candidate plant species. Natural Heritage Report 2020-01. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 97 pp.

Joyal, E. 1990. New variety of *Oxytropis campestris* (Fabaceae) from the Columbia Basin, Washington. Great Basin Naturalist 50(4): 373-377.

Rocchio, F.J. and R.C. Crawford. 2015. Ecological systems of Washington State. A guide to identification. Natural Heritage Report 2015-04. Washington Natural Heritage Program, WA Department of Natural Resources, Olympia, WA. 384 pp.

Rocchio F.J. and T. Ramm-Granberg. 2017. Ecological System Climate Change Vulnerability Assessment. Unpublished Report to the Washington Department of Fish and Wildlife. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.

Young, B.E., E. Byers, G. Hammerson, A. Frances, L. Oliver, and A. Treher. 2016. Guidelines for using the NatureServe Climate Change Vulnerability Index. Release 3.02. NatureServe, Arlington, VA. 48 pp. + app.